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ORNL 328
WASTE DISPOSAL

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TECHNICAL DIVISION

PROCESS DESIGN SECTION

LIQUID WASTE DISPOSAL AT OAK RIDGE NATIONAL LABORATORY

BY

F.N. BROWDER

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ORNL - 328

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Technical Division

Process Design Section

LIQUID WASTE DISPOSAL

AT OAK RIDGE NATIONAL LABORATORY

CLASSIFICATION CANCELLED

DATE ... 1960

BY

F. N. Browder

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

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0.0 Abstract

The four types of liquid waste from ORNL processes are described, and the method of handling each is explained. The waste tanks are listed and the status of the storage facilities described. Recommendations for correcting existing faults in the waste disposal system are made, and possible future developments in waste decontamination are listed.

1.0 Summary

Liquid waste from ORNL processes can be classified into four types according to composition and radioactivity. These types are:

Radiochemical Waste, which is highly radioactive (average $2.5 \times 10^5\ \beta$ Counts per minute per milliliter) and which has as its source special "hot" sinks and vessels in cells devoted to "hot" work;

Metal Waste, which is plutonium, uranium, or thorium-bearing waste and which is usually highly radioactive (average $10^5\ \beta$ c/m/ml);

Warm Waste, which is moderately radioactive (average $10^4\ \beta$ c/m/ml or less) and is handled according to the intensity of its activity;

Process Waste, which is theoretically non-radioactive and which is derived from cooling water, laboratory sinks other than "hot" sinks, and floor drains outside facilities devoted to "hot" work. The pile canal overflow also drains to this system.

The sanitary waste system is beyond the scope of this report.

The liquid waste disposal system is geographically divided into the North Tank Farm, the South Tank Farm, and the Settling Basin Ares. These areas contain a number of concrete tanks buried at least six feet deep and four earthen-diked ponds. In addition to this main system, there are waste tanks located near several process and development buildings. Drawing TD-889 shows the geographical location of each of these tanks and ponds, and Table I lists them with their capacities, construction, and present contents. (see page 13A).

The function of the tank farms is to collect and store metal waste, and to collect and hold radiochemical waste until sufficient decay permits discharging it to White Oak Creek at a rate not to exceed 5 curies of activity per 24 hrs.. The ponds collect this decayed radiochemical waste and dilute it with sufficient quantities of non-radioactive waste to permit discharging it to the creek. The tanks near the process and development buildings serve as intermediate hold-up before the waste is sent to the tank farms. Radioactive metal and chemical wastes from other A. E. C. sites are also received at the ORNL tank farms.

Estimates of the average weekly flows of the four waste streams were made based on records of the tank farm operations and statements of personnel in charge of each waste contributing source. Estimates of flows were necessary because no records are kept of waste contributed by each source.

These estimates are:

Metal Waste averages 1500 gallons per week. The fissionable metal in this waste is precipitated and stored in certain tank farm tanks. The supernate from the precipitations is treated to remove ruthenium and sent to the radiochemical waste system.

Radiochemical Waste averages 30,000 gallons per week including part of the warm waste. This total flow is held in certain tank farm tanks for an average of about one month and then sent to the Settling Basin for dilution with process waste and discharge to the creek.

Warm Waste averages 75,000 gallons per week. This is collected in 8000 gallon batches in tanks W-1 and W-2, analyzed for activity, and sent to the radiochemical system if the activity exceeds 25,000 β c/m/ml. Normally the count is lower than this, so that this waste is sent to the process system.

50
2×10^3
100×10^3 gal

Process Waste averages two to four million gallons per week. This drains directly to the Settling Basin. The activity averages 100 β c/m/ml.

At the present time the four waste streams are not kept entirely separate. Because of inadequate facilities at the waste sources, some radiochemical waste is allowed to drain into the warm and process systems. Too large a volume of non-radioactive waste is allowed to flow into the radiochemical and warm waste streams.

Part of the metal waste stream flows through lines used by the radiochemical stream. Not all process and development buildings have individual waste collection tanks, so that it is impossible to regulate the flows of the waste streams. These flows vary extremely from time to time because of the nature of some of the operations at ORNL. The larger collection and hold-up tanks are of concrete construction and, therefore, they can not handle acid wastes. This fact requires neutralization of acid waste, which is not always desirable.

In order to correct these faults it is recommended that all unnecessary cross-overs between the four waste streams be eliminated, that additional "hot" sinks be provided, and that stainless steel tanks be installed at all buildings requiring them. These changes would considerably facilitate concentrating and decontaminating active wastes. It is also recommended that surveys be made to determine if revision of present ORNL processes can be made in order to reduce the volume of active waste. A survey to determine the feasibility and economy of the proposed stainless steel tank additions is already planned.

If a volume reduction of 20 to 1 can be effected on the radiochemical waste stream by means of evaporation, the existing facilities in the tank farm will afford storage for chemical waste concentrate for three years assuming present plus known future flows. An evaporator capable of accomplishing this volume reduction and more at a rate of 300 gallons per hour and a decontamination factor of 10^3 is being constructed in the South Tank Farm. Development work on resin adsorption of activity and crystallization of salts out of active wastes is being carried out at the present time as possible alternate processes to evaporation or as supplementary steps to evaporation.

2.0 Introduction

2.1 Purpose

At the present time, radioactive liquid waste from Oak Ridge National Laboratory is discharged to White Oak Creek, a tributary of the Clinch River. The liquid waste disposal facilities consist of a tank farm built in 1943 to collect and store precipitated radiochemical waste as well as plutonium and uranium-bearing waste. This tank farm was to serve for a maximum of three years, but continued operation of ORNL necessitated abandoning the precipitation and storage of active waste not containing uranium or plutonium, and changing part of the waste storage system to a temporary hold-up system. In 1944 the large Settling Basin was built to provide a settling space for precipitated activity and a facility for diluting partially decayed, dissolved, radioactive waste with large volumes of non-active waste before discharge to White Oak Creek. A limit of five curies of radioactivity per day was established for the discharge to White Oak Creek; this limit has been maintained for the past three years.

It has long been known that the discharge of radioactive waste constitutes a potential health hazard, and the necessity for providing means of removing radioactive poisons from ORNL liquid waste has been apparent for several years. Because of the gradual increase of activity in muds and waters of surrounding streams, major effort will be expended to correct the liquid waste problem.

It has been proposed that the existing waste system be altered and enlarged. In order to provide information upon which sound decisions as to what corrective measures are required and justified, this survey of the liquid waste system has been prepared.

2.2 Method of Presentation

In this report the information collected in the survey is presented; the present liquid waste disposal system is described; its function is explained, and some recommendations for improving the system are made. The explanation of the function of the system is presented according to the sources, quantities, compositions, and methods of handling the four types of ORNL liquid waste. This information was gathered by studying all available prints and reports on the waste systems and by contacting the personnel in charge of each waste contributing operation. Samples of certain waste streams were taken to determine composition, but much of the data on quantities and compositions are estimates based on operating experience. Reference reports and drawings are given in the appendix.

2.3 Nomenclature

Identification of any one of the four liquid waste streams at ORNL is frequently difficult since no official names have been assigned; different groups call the same stream by different names. In this report each stream has been assigned a name descriptive of its composition. The four liquid waste streams at ORNL are:

Radiochemical Waste, which is highly radioactive (ave. $2.5 \times 10^5 \beta$ c/m/ml and $10^2 \gamma$ c/m/ml) as compared to the other waste streams and which has as its source special "hot" sinks, vessels in cells devoted to "hot" work, and certain drains used in the decontamination of equipment.

Metal Waste, which is plutonium, uranium, or thorium-bearing waste, and which is usually highly radioactive ($10^5 \beta$ c/m/ml and higher).

Process Waste, which is theoretically non-radioactive and which is primarily derived from cooling water, floor drains outside of facilities devoted to "hot" work, laboratory sinks other than "hot" sinks, and the pile canal overflow.

Warm Waste , which is moderately radioactive (ave. $10^4 \beta$ c/m/ml) and is handled according to the intensity of its activity.

The sanitary waste system and the open-ditch system for certain cooling water and steam condensate streams are beyond the scope of this report.

3.0 <u>Present Status of the Waste Tank System</u>

The liquid waste disposal system is geographically divided into three main sections:

1. <u>The North Tank Farm</u> - containing two 4400 gallon and two 40,000 gallon gunite tanks.
2. <u>The South Tank Farm</u> - containing six 170,000 gallon, one 1300 gallon gunite tanks and one 700 gallon stainless steel tank.
3. <u>The Settling Basin Area</u> - containing one 1,600,000 gallon, one 32,000 gallon and two 293,200 gallon earthen-diked ponds.

In addition to this main system, there are waste tanks located near the following process and development buildings:

1. <u>706-A Metal Waste Tank</u> - located south of Bldg. 706-A, constructed of concrete and approximately 14,000 gallons in capacity.
2. <u>706-HB Metal Waste & Radiochemical Waste Tanks</u> - two stainless steel tanks each of 1200 gallon capacity located south of Bldg. 706-HB.
3. <u>706-C Metal Waste Tank</u> - one 1700 gallon stainless steel tank located west of Bldg. 706-C.
4. <u>Hot Pilot Plant Plutonium Waste Tank</u> - one 2000 gallon stainless steel tank located in Cell 4 of Bldg. 205.

5. Bldg. 706-G (Ra & Be Source Bldg.) one 375 gallon stainless steel tank for warm waste.
6. Bldg. 115 Pile Fan Seals and Cells- one concrete pit for warm waste.
7. Bldg. 105 Hot Lab one 200 gallon stainless steel tank for warm waste.
8. Hexone Still one 55 gallon stainless steel drum with condenser located near tank W-10 in the South Tank Farm.
9. Ruthenium Recovery Unit one 630 gallon stainless steel tank for Ru treatment and one 2150 gallon stainless steel tank for Ru storage.

Drawing TD-889 shows the approximate geographical locations of each of the above waste tanks.

3.1 Tanks in the ORNL Liquid Waste System

Table I lists the waste tanks, their locations, capacities, construction, and present contents.

3.2 General Functions of the Tank Farm & Waste Disposal System

The tank farm provides collection and hold-up facilities for liquid waste from the Restricted Area, in which all work with radioactive elements at ORNL is performed. Tanks W-1 and W-2 in the North Tank Farm collect and hold the total warm waste stream until quick gross activity analysis of samples from these tanks determines whether it is necessary to hold the contents for activity decay in Tank W-5 or to discharge them to the Settling Basin.

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TANK NO.	MATERIAL OF CONSTRUCTION	LOCATION	CAPACITY, GAL.	Dia. FEET	Heigth FEET	TYPE OF WASTE HANDLED
W-1	Gunite	North Farm	4,400	12'	5'	Warm waste
W-2	Gunite	North Farm	4,400	12'	5'	Warm waste
W-3	Gunite	North Farm	41,300	25'	10'	Hot Pilot Plant Radiochemical waste
W-4	Gunite	North Farm	41,300	25'	10'	Hot Pilot Plant Metal waste
W-5	Gunite	South Farm	170,000	50'	12'	Radiochemical
W-6	Gunite	South Farm	170,000	50'	12'	Radiochemical
W-7	Gunite	South Farm	166,000	50'	12'	U solution + ppt.
W-8	Gunite	South Farm	170,000	50'	12'	U solution
W-9	Gunite	South Farm	165,000	50'	12'	U solution
W-10	Gunite	South Farm	170,000	50'	12'	U solution + ppt.
W-11	Gunite	South Farm	1,700	9'	6'	Radiochemical
W-12	Stainless Steel	South Farm	700	-	-	Radiochemical
706-A Metal Waste	Gunite	South of 706-A	14,000	-	-	U & Th solution + ppt.
706-HB Metal Waste	Stainless Steel	South of 706-HB	1,200	6'	6'	Metal waste from semi-works
706-HB Chem. Waste	Stainless Steel	South of 706-HB	1,200			Radiochemical waste
706-C Metal Waste	Stainless Steel	West of 706-C	1,700	9'	6'	Metal waste U & Pu
Hot Pilot Pl. Pu Waste	Stainless Steel	Cell 4 in Bldg. 205	2,150			Pu metal solution
706-G Waste Tank	Stainless Steel	South of Bldg. 706-G	400			Radiochemical
Pile Hot Lab Tank	Stainless Steel	South of Bldg. 105	375	4'	4'	Radiochemical

/ OF WASTE TANKS

ATIONAL LABORATORY

Drawing # 6479

TABLE I

FUNCTION	TOTAL GALLONS STORED 11-1-48	VOLUME OF SOLIDS, GALLON	FUTURE STORAGE CAPACITY, GALLON	REMARKS
ollection and diversion tank for warm waste	0	0	—	
ollection and diversion tank for warm waste	0	0	—	
ollection tank for Hot Pilot lant radiochemical waste	11,700	1,300	29,600	
ollection tank for Hot Pilot lant metal waste	28,250	5,850	13,050	
ollection and temporary hold- p tank for radiochemical waste	78,400	41,600	128,400	Available Vol., for solids.
eceives supernate from W-5 before ischarge to Settling Basin	114,400	26,000	—	Varies
recipitation and Storage of U; upernate to Ru recovery & W-12	153,400	28,600	137,400	For Solids
ollection and temporary storage f liquid U solutions	85,800	6,500	—	Varies
ollection and distribution tank or liquid U solutions	109,200	18,200	—	Varies
recipitation and storage of U; upernate to Ru recovery & W-12	123,500	46,500	123,500	For solids
verflow and diversion tank for adiochemical waste received in W-12	0	0	—	
ollection tank for radiochemical aste; feeds W-5	0	0	—	
tores metal waste from semi-works ontaining U & Th	10,000	-	4,000	
ot yet in use	0	0	1,200	
ollects radiochemical waste from emi-works; feeds W-5	0	0	1,200	
ollection and temporary storage f Bldg. 706-C metal waste	Varies	Varies	—	
ollect and hold Pu waste from edox process	400	—	1,600	
ollection tank for lab. waste; eeds W-1 & W-2	Varies	—	—	
ollection tank for lab. waste; eeds W-1 & W-2	Varies	—	—	

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Tank W-3 in the North Tank Farm was formerly used to store precipitated aluminum-plutonium and uranium wastes, mostly from the Hot Pilot Plant. It is now used to store the Hot Pilot Plant radiochemical waste because of the high activity and long half-life of this waste. Tank W-4 in the North Tank Farm is used to store uranium precipitated from Hot Pilot Plant metal waste. This tank has a truck pad and jet for receiving uranium-bearing wastes from sites other than ORNL.

Tanks W-5, W-6, W-11, and W-12 in the South Tank Farm are used to handle the total radiochemical waste stream. Tank W-12 is the small stainless steel receiving tank for most of this waste. It automatically jets its contents to W-5 or overflows to W-11. Tanks W-5 and W-6 are the large concrete hold-up tanks for the radiochemical waste stream. Together these tanks provide about one month's hold-up for the average 30,000 gal. per week flow of this waste stream. The East and West Ponds in the Settling Basin Area provide emergency hold-up capacity for the radiochemical waste stream when the flow is too great for tanks W-5 and W-6 to provide sufficent hold-up time for activity decay.

Tanks W-7, W-8, W-9, and W-10 in the South Tank Farm are used to collect and store uranium-bearing waste. Tank W-9 is the receiving and dispersing tank, and W-7 and W-10 are used for precipitating the uranium. Because it belongs to the radiochemical waste system, tank W-8 is used for temporary storage of liquid uranium waste only.

The Settling Basin in the Settling Basin Area collects all the Restricted Area liquid waste that is not stored and discharges it to White Oak Creek at a rate not exceeding 5 curies of radioactivity per day. The hold-up in the Settling Basin is about three days.

The Retention Pond in the Settling Basin Area collects liquid from the dry-well system for the Tank Farm and discharges it to White Oak Creek.

All the concrete tanks in the North and South Tank Farms are located below ground level and are surrounded by a layer of 2 inch crushed stone for about 3 feet from their sides. The remaining space is filled with earth, and all the tanks are covered with 5 to 6 feet of earth. Each tank is provided with a "dry well". This is a 2 feet x 2 feet concrete pit of sufficient depth to extend from ground level to a point below the pad on which the tank rests (see Figure I). A 6 inch terra cotta line permits leakage collecting on the pad to drain into this well. There is a connection to a 6 inch terra cotta sewer line enough below the drainage inlet to give an 8 inch deep retention. This line from each tank in turn connects to an 8 inch terra cotta line that discharges into the Retention Pond, from which the drainage overflows into the creek.

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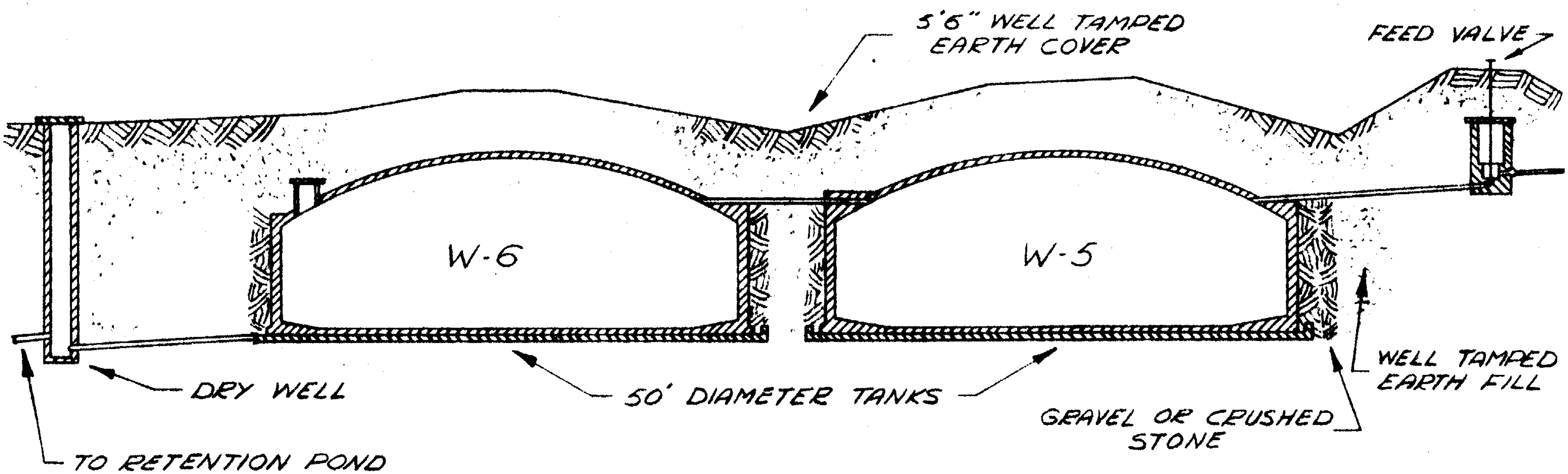

FIGURE I
GUNITE WASTE TANKS
TYPICAL SECTION

No other activity-bearing liquid is sent to the Retention Pond. This pond is sampled several times every day, and when its radioactivity count increases, the activity can usually be traced to a leak. Hexone from the Hexone Still is discharged into the tank W-10 dry well and thus drains to the Retention Pond.

Drawing TD-883 schematically shows the flows of the four waste streams from the sources of each to final disposal.

A truck pad and discharge system to either the radiochemical waste or metal waste systems has been installed in the South Tank Farm to receive wastes from other sites.

4.0 Radiochemical Waste System

4.1 Sources and Quantities

Table II

Source	Estimated Average Quantity, Gals./Wk.	Estimated Max. Quantity Gals. /week.
Bldg. 706-A	500	2000
Bldg. 706-C	2000	10,000
Bldg. 706-D	10,750	50,000
Bldg. 205	500	10,000
Bldg. 706-HB	100	2000
Ru Recovery Unit	10,000	20,000
W-1 & W-2 (warm waste)	2000	20,000
New Radio Isotope Area	2000	5000
Totals (est.)	27,850	119,000
Totals (statistical)	30,600	60,000

The 30,600 gal per week figure was taken from records of the flow to tank W-5 for twenty-one weeks between Nov. 2, 1947, and March 27, 1948, covering three RaLa runs. The average flow over forty weeks, including the above twenty-one weeks and covering six Rala runs, was 27.800 gal per week. The estimated average from each source was arrived at by the people in charge of the operations at the source of waste. The divergence between the statistical and estimated averages is not exceedingly great in view of the fact that no records are kept of waste contributed by each source. The total estimated maximum flow is greater than the statistical maximum because all sources do not contribute a maximum at any one time. The probability of such an event is not great, since the RaLa runs and cell decontaminations, which produce the maximum flows of waste, do not occur simultaneously.

It is recommended that for design purposes, the flow of radiochemical waste be set at 30,000 gal per week, with surge capacity set at 60,000 gals per week.

4.2 Method of Handling Radiochemical Waste

Radiochemical Waste comes from hot sinks, hot hoods, vessels in hot cells, and certain drains in hot cells in the Restricted Area. The system is set up as follows:

Bldg. 706-A has a 3 inch stainless steel hot drain, which connects to hot drains in the Semi-works and Rooms 15, and 21 in the east wing, and to hot drains in Rooms 65,73, and 78 in the west wing. Proposed additional drains in the east wing should be connected to this 3 inch stainless steel line, which drains to tank W-12.

Bldg. 706-C has a 3 inch stainless steel hot drain, which connects to two hot sinks, eight cells, seven hoods, and one vault in the building. This hot line drains to tank W-12.

Bldg. 706-D has a 2 inch stainless steel drain, which is connected to vessels in the cells, two hot sinks, a sump from the cell vessel off-gas system, and a jet in the cell off-gas duct. This 2 inch line drains to the Bldg. 706-C 3 inch hot drain to W-12 outside of Bldg. 706-C.

Bldg. 706-HB has a 1200 gal stainless steel collection tank for radiochemical waste. This tank is fed from a drain in each cell (two in each large cell), from the decontamination area, from hot hoods, and from several other drains outside the cells. This tank has a total draw-off jet, which discharges through a 2 inch stainless steel line to tank W-5, and a decant jet, which discharges through a 2 inch stainless steel line to a 6 inch vitreous pipe line to the Settling Basin.

Bldg. 205 has two 3 inch stainless steel hot drain lines that connect the Bldg. 205 cells to the tank farm. One of these lines (shown at N22,484.75 on TD-889) leads from a drain opening on the east wall of cells 2,3,4,5, & 6 and the west wall of cell 1 to tank W-5. By means of a valve arrangement (shown near N22,290 on TD-889) waste sent through this line can be diverted to tanks W-3 & W-4. The Hot Pilot Plant is the main contributor to this line from waste neutralizer tanks in cells 1 & 2. Radiochemical waste from the Hot Pilot Plant operations normally is sent to tank W-3 through this system. Normally the valve in this line at W-4 is kept closed and the one at W-3 is kept open for the flow of radiochemical waste from cells 1 & 2 to W-3. The use of W-3 instead of W-5 to receive and store this waste is a recent procedure necessitated by the production of large quantities of long lived activity from Hanford slugs used in the Hot Pilot Plant investigations. Other radiochemical waste of lower activity levels, such as tank rinses, is sent to W-5.

The other 3 inch stainless steel drain line (shown at N22, 484.0 on TD-889) leads from a drain opening on the west walls of cells 2,3,4,5,& 7 to the valve arrangement shown near N22,290 on TD-889. The Hot Pilot Plant normally uses this line to discharge its metal waste from the neutralizer in cell 2 to tank W-4 in order to keep radiochemical and metal waste separate as much as possible. Cell 1 has no connection to this line.

The Ruthenium Recovery Unit, which removes Ru from metal waste supernate after the source and fissionable materials have been precipitated, has a jet with a 2 inch discharge line to tank W-12 for transferring the exhausted metal supernate and other process solutions to the radiochemical waste system.

Tank W-12, receives radiochemical waste from Bldgs. 706-A, 706-C, 706-D, and the ruthenium recovery unit. W-12 also receives metal waste from the Bldg. 706-C metal waste tank. The metal waste is immediately jetted to tank W-9. This metal transfer occurs about once every three months and is made only when tank W-12 is otherwise idle. Normally, W-12 automatically jets its contents to W-5 by means of a float-operated jet. During periods of heavy loading, or when the waste contains very little activity, W-12 is allowed to overflow to tank W-11 in order to by-pass W-5. Tank W-11 has a 3 inch chemical-ware bottom drain with a stainless steel valve to the Settling Basin.

Tank W-5 receives radiochemical waste from W-12, from Bldg. 706-HB, Bldg. 205, and from trucks which bring waste from other sites. W-5 also receives waste from tanks W-1 and W-2 when their contents read over 25,000 β Counts per minute per ml.

The 32 inches of sludge in the bottom of tank W-5 is a result of previous precipitation of contaminated chemical waste with Na_2CO_3 and $CaCl_2$. Precipitation of contaminated chemical waste was abandoned in 1945.

Under the present system of waste disposal, as tank W-5 becomes filled with liquid, the 2 inch Hanford-type jet with 2 inch dia. dip-leg extending through the sludge to within 2 inches of the bottom of W-5 is used to transfer the contents to W-6. This jet has a capacity of 60 gal. per minute, and can transfer the contents of the W-5 to W-6 in one day. Samples are taken from W-6 as it empties, and the rate of discharge from W-6 to the Settling Basin is determined by the activity reading of these samples.

Tank W-6 has two jets to the Settling Basin. One jet is 1/2 inch with a 3/8 inch dia. dip-leg, and has a capacity of 3 gal-per minute; the other has a capacity of 50 gal-per min. Samples are taken three times per shift at both the intake and discharge sides of the Settling Basin to insure against exceeding the limit of five curies per day discharged to White Oak Creek.

Radiochemical waste is usually held up about one month in tanks W-5 and W-6 before it is discharged to the Settling Basin. The retention time in the Settling Basin is approximately three days, although there is some indication that a considerable quantity of activity is absorbed in the pond, probably by the clay in the bottom. The East and

West Ponds serve as emergency hold-up reservoirs when the volume and / or the activity of waste is great enough to exceed the 5 curies per day limit on the discharge to the creek.

4.3 Composition of Radiochemical Waste

Samples were taken from tank W-12 three times each day during the period between July 8, 1948, and October 10, 1948. These samples are not completely representative of the flow through W-12 because this flow varies so greatly. The analyses of these samples, however, are a qualitative indication of the composition of this waste. Each of these samples was analyzed for gross activity, pH, and total solid (T.S.); all the samples for each of the first five weeks were composited once per week and analyzed for individual fission products and certain ionic composition. After the fifth week, the individual fission product analyses were discontinued, and the weekly composites were made for ionic analyses only. The results of these composite analyses are listed in Table III.

From the analytical results, the following general conclusions can be drawn:

1. Gross activity averages 5×10^4 β c/m/ml*
2. Gross activity averages 10^2 γ c/m/ml*
3. The pH is usually greater than 7
4. The total solid content averages about 50 mg/ml

[redacted]

Drawing # 7041

TABLE III

Tank W-12 Analyses in 1948

Weekly Composite Number	Date of Samples in Composite	Gross β c/m/ml	Gross γ c/m/ml	TRE* c/m/ml	Ru β c/m/ml	Zr β c/m/ml	Cb β c/m/ml	Cs β c/m/ml	I β c/m/ml	Sr β c/m/ml	pH	T.S** mg/ml	U mg/ml	Na mg/ml	Al mg/ml	Cl mg/ml	F mg/ml	CO_3 mg/ml	SO_4 mg/ml	NO_3 mg/ml	PO_4 mg/ml
1	7-6 to 7-11	8.8×10^4	215	180	est 1000	est 1000	est 1000	1.02×10^3	7.4×10^4	55	10.0	5	0.007	1.9	0.01	0.4	.003	1.2	0.2	.001	6.7
2	7-12to 7-17	2.8×10^5	580	156	est 500	68	est 100	2.54×10^2	2.2×10	270	9.0	20	0.2	5.0	0.2	0.5	.002	1.9	0.6	.002	11.3
3	7-19to 7-23	2.9×10^4	94	1278	est 300	139	est 300	est 300	3×10^4	est300	9.0	12	0.03	3.0	0.07	0.3	.002	1.0	0.5	.082	6.2
4	7-26to 7-31	2.5×10^5	1000.	1.1×10^6	est 1000	$2x\ 10^4$	est 3000	est 8×10^4	3x 10	4×10^4	3.0	7	0.04	0.2	0.6	0.14	.003	0.3	0.54	.010	7.3
5	8-2 to 8-8	7×10^4	est 1000	5×10^4	est 1000	294	est 300	est 3×10^4	1×10^3	2×10^3	4.0	4	0.02	0.6	0.2	0.16	.006	0.5	0.5	.006	1.9

After the fifth week composites were made only for the ionic analyses of U, Na, Al, Cl, F, CO_3, SO_4, NO_3, and PO_4. These are as listed in the columns immediately below: The analyses listed below are the averages or the maximum and minimum values for the components in the samples for each week:

Weekly Composite Number	Date of Samples in Composite	Gross β c/m/ml	Gross γ c/m/ml	TRE* c/m/ml	Ru β c/m/ml	Zr β c/m/ml	Cb β c/m/ml	Cs β c/m/ml	I β c/m/ml	Sr β c/m/ml	pH	T.S** mg/ml	U mg/ml	Na mg/ml	Al mg/ml	Cl mg/ml	F mg/ml	CO_3 mg/ml	SO_4 mg/ml	NO_3 mg/ml	PO_4 mg/ml
6th Week	8-9 to 8-15	est 10^4	est 10^2								0.6 to 11.3	0to 33.4	0.035	1.3	0.3	0.15	.002	0.86	0.66	.07	5.9
7th Week	8-16 to 8-22	ave 10^5	ave 10^2								0.6 to 11.3		0.24	3.7	0.13	0.40	.005	1.0	0.47	0.17	3.3
8th Week	8-23 to 8-29	ave 10^4	ave 10^2								0.6 to 11.3		0.19	6.6	0.26	0.30	.005	2.57	0.10	0.69	8.7
9th Week	8-30 to 9-5	ave 10^4	ave 10^2								0.6 to 11.3	0to 33.1	0.12	4.3	0.01	0.4	.009	2.1	1.38	5.5	0.4
10th Week	9-6 to 9-12	ave 10^4	ave 10^2								0.6 to 11.3	0to 69.9	0.14	11.2	0.001	0.36	.015	6.2	4.7	4.4	1.4
11th Week	9-13 to 9-19	ave 10^4	ave 10^2								0.6 to 11.3	.6to114	0.08	24.7	0.021	0.6	.007	14.0	8.6	6.7	3.3
12th Week	9-20 to 9-26	ave 10^4	ave 10^2								0.6 to 11.3	.3to 105	0.5	18.5	0.001	0.80	.008	11.0	7.0	4.8	1.7
13th Week	9-27 to 10-3	ave 10^4	ave 10^2								0.6 to 11.3	38to 126									

Notes: RaLa runs were made 7-6 to 7-13, 1948; 7-13 to 7-23, 1948; and 8-25 to 9-4, 1948

Radio-chemical analyses were made by G. Ledicott; ionic analyses were made by J.H. Edgerton

*TRE means Total Rare Earths

**T.S. means Total Solids

[redacted]

Drawing # 7040

TABLE IV

Radiochemical Analyses of Feed Solutions for

Pilot Plant Evaporator

Run No.	pH	Total Solids gm/L	Disintegrations per minute per milliliter								
			Gross β	Gross β	Ru β	Zr β	Ce β	Sr β	Cs β	TRE* (-Ce) β	I^{131} β
1 (Supernate)	9.20	17.2	1.07×10^6	0.03×10^5	0.38×10^5	0.01×10^5	0.32×10^5	0.87×10^5	4.2×10^5	0.48×10^5	3.07×10^5
1 (Sludge)	---	all	7.0×10^7	--------	0.9×10^5	0.6×10^5	19.0×10^5	3.1×10^5	0.9×10^5	21.0×10^5	neg.
2 (Supernate)	4.20	20.0	4.99×10^6	0.13×10^5	0.61×10^5	0.42×10^5	17.3×10^5	0.37×10^5	0.56×10^5	0.78×10^5	18.6×10^5
3 (Supernate)	4.10	17.6	9.66×10^6	6.0×10^5	1.10×10^5	0.23×10^5	34.0×10^5	15.0×10^5	6.94×10^5	13.7×10^5	1.95×10^5
4 (Supernate)	7.70	10.3	3.50×10^6	[illegible]$.0 \times 10^5$	1.30×10^5	0.13×10^5	2.67×10^5	16.4×10^5	9.20×10^5	2.93×10^5	1.77×10^5
5 (Supernate)	7.20	10.5	3.96×10^6	9.0×10^5	0.11×10^5	0.91×10^5	2.37×10^5	12.6×10^5	1.05×10^5	3.41×10^5	0.58×10^5

* Total rare earths less cerium

[redacted]

Drawing # 7039

[redacted]

TABLE V

Ionic Analyses of Feed Solutions
for Pilot Plant Evaporator

Analysis	Concentration gm/liter	
	Acid Samples	Basic Samples*
U	0.88	0.026
Na	2.1	9.5
Ca	0.037	0.01
Mg	0.005	0.01
Al	0.07	0.4
Fe	0.003	0.001
Cl	0.26	0.35
F	0.005	0.005
CO_3	0.50	2.75
SO_4	0.50	0.9
PO_4	0.003	0.002
NO_3	7.9	17.7

* Represents average results of weekly composites taken over period 7-26-48 to 8-28-48.

[redacted]

5. The major components of the dissolved solids are:

   a. Na--10 mg/ml

   b. CO_3--5 mg/ml

   c. SO_4--5 mg/ml

   d. PO_4--5 mg/ml

   e. Cl--0.5 mg/ml

* Since these samples were taken, the RaLa process has begun to use Hanford slugs. The activity level of the waste from Bldg. 706-D to W-12 during a RaLa run, therefore, averages between 10^5 and 10^6 βc/m/ml and 10^5 γc/m/ml. This activity decays sufficiently in W-5 & W-6 to prevent exceeding the 5 curie per day limit on discharge to the creek.

The composition of the waste in tank W-5 is shown by Tables IV and V, which were taken from S. E. Beall's report ORNL 224, "Pilot Model Evaporator for Concentration of Radioactive Wastes". At the time this information was gathered, the Hot Pilot Plant had just begun to use Hanford slugs and was still discharging its radiochemical waste to W-5. These data are still representative because of the Hanford slugs from Bldg. 706-D.

5.0 Warm Waste System

Warm Waste is the intermediate volume (estimated average 75,000 gal. per week) and itermediate activity (about 10,000 βc/m/ml) waste. When its activity is less than 25,000 βc/m/ml, it is handled like process waste and sent to the Settling Basin. When the activity of specific contributors to this stream is greater than 25,000 βc/m/ml, the highly active portions are treated like radiochemical waste and sent to tank W-5 for retention. The volume of the warm waste at times reaches 150,000 gal. per week, but on such occasions its activity is low enough to permit immediate discharge to the Settling Basin.

5.1 Sources

The sources of the warm waste are: condensate from three steam jets which evacuate off-gas systems for the cell vessels in the Hot Pilot Plant in 205 Bldg. and the cell vessels in Bldgs. 706-C & D; the cell catch tank in Ra and Be source Bldg. 706-G; Bldg. 205 cell floor drains and roof drains; Bldg. 105 hot lab. catch tank; Bldg. 115 fan cell floor drains and seal pits.

5.2 Method of Handling

All the sources of warm waste drain to a 6 inch terra cotta line, which runs from Bldg. 205 to tanks W-1 and W-2. These tanks fill simultaneously and are sampled when they are nearly full to determine the activity, which seldom exceeds 25,000 β c/m/ml. The warm waste is usually handled in the process waste system described in Section 6.0 The warm waste can be diluted by diverting part of the pile canal overflow to tank W-1 and W-2, but this is seldom done. A Na_2CO_3 heel is added to W-1 and W-2, each time they are drained to insure a basic solution at all times in these concrete tanks.

6.0 Process Waste System

Process waste is large volume waste (2 to 4 million gallons per week) with very low activity (average 100 c/m/ml.)

6.1 Sources

The sources of process waste are: floor and sink drains in all buildings in the restricted area that are not "hot" drains or "warm drains". These buildings are 706-A, 706-B, 706-C, 706-D, 706-G, 204, 104-B, 101-D, 205, 706-HB. In addition to this, the pile canal overflow and cooling water from pile holes 12 and 19 drain to the process system.

6.2 Method of Handling

A 15 inch vitreous-pipe (V.P.) drain runs from (see TD-899) Manhole # 22 near the southeast corner of Bldg. 205 west to Manhole # 19 at the southwest corner of Bldg. 205, then south to Manhole # 25 near tank W-2, then west a few feet to Manhole # 24 near tank W-1, then south to Manhole # 16 at the southwest corner of the tank farm, then east to Manhole #52 south of W-10, and finally south to Manhole # 84, from which it drains either to the East and West Ponds or to the Settling Basin. This line collects process waste from Bldgs. 115, 105, 101, 205, and the pile canal overflow at Manhole # 22. Process waste from Bldgs. 706-G, and 204 joins this line just south of the center of Bldg. 205. This line collects process waste from Bldgs. 101-D, 104-B and 706-B at Manhole # 19.

An 8 inch V. P. drain collects process waste from Bldgs. 706-A, 706-C, and 706-D and delivers it to the 15 inch V. P. line at Manhole # 52 south of W-10. A 30 inch V. P. drain from the rolling mill Bldg. 101-B, and the New Isotope Area joins the first 15 inch line at a new manhole north of the Settling Basin, and a 6 inch V. P. line delivers Bldg. 706-HB process waste to the 30 inch line at this same manhole. All other process waste drains directly to White Oak Creek.

Outside the Restricted Area the laundry, Bldg. 723, and the steam plant, Bldg. 801-D, discharge process waste through an 8 inch V. P. line to White Oak Creek. A check on the activity of this waste is maintained by the Health Physics Division.

Samples of Restricted Area waste are taken at the intake and discharge sides of the Settling Basin once each shift to check activity.

7.0 Metal Waste System

Metal Waste is uranium, plutonium, or thorium-bearing waste. A total of 140,582 kg of U is stored in the tank farm as a basic slurry at the present time (March 24, 1949). The quantity of Pu stored is not known. The quantity of Th stored is about 200 kg.

7.1 Sources and Quantities

Bldg. 706-C. produces an average of 75 gal. of uranium waste per week.

Bldg. 706-D produces an average of 4550 gallons of uranium waste each time a RaLa run is made using Clinton slugs and approximately 1200 gallons using Hanford slugs. RaLa runs are made about one every seven weeks. This is an average of 650 gal/wk on a yearly basis. The Clinton RaLa run will contain approximately 1100 kg. of uranium, while a Hanford RaLa run will contain approximately 270 kg. of uranium.

Bldg. 706-A Semi-Works produces an average of 100 gallons of uranium sludge per week containing uranium from two Clinton slugs. Dead uranium averaging 30 kg/wk. is added to the Semi-Works Redox runs.

The Hot Pilot Plant at Bldg. 205 produces 400 gallons of 0.5 M. uranyl nitrate solution per week and will continue to do so until April 1, 1949. After that, there will be about 2000 gallons of Pu and 1.3 M $Al(NO_3)_3$ waste having an activity reading of $10^7 \beta$ c/m/ml and averaging 500 gallons per week for four weeks.

Bldg. 706-HB will produce approximately 200 gallons per week of Th-Al waste after "23" runs start. This will be stored in the thorium tank at Bldg. 706-HB.

7.2 Method of Handling Metal Waste

Bldg. 706-D Metal Waste is collected in the A-6 neutralizer, where it is made alkaline with Na_2CO_3 or Na_3PO_4. It is then jetted to tank W-9.

Bldg. 706-C Metal Waste is collected in a 1700 gal tank at Bldg. 706-C. The radiochemical waste line is used for the collection and transfer of metal waste as well as chemical waste, so special arrangement must be made to prevent mixing radiochemical waste with the metal waste each time any waste is handled. The 706-C tank is emptied by jetting to tank W-12 then to W-9 about once every three months. Approximately 1000 gallons are transferred each time.

Bldg. 706-A has a metal waste tank near the building, which is now about 70% full of alkaline uranium sludge and supernate. It is estimated that the sludge is one foot deep in the tank, and that it contains 637 mg/gm of uranium with a count of 3.5 x 10^6 c/m/ml. The supernate is 41 inches deep and contains 9.6 mg/ml of uranium, reads 760 β c/m/ml, and had a pH of 9.8. The tank is known to have a thorium content of eleven Hanford thorium slugs and thirty to forty $ThCO_3$ slugs, or a total of about 24 kg. of thorium. About 200 to 300 gal of 2 M with respect to thorium is stored in 50 gal stainless steel drums near Bldg. 706-A It is planned to transfer this to the thorium tank at Bldg. 706-HB in the near future. The metal waste tank at Bldg. 706-A is no longer used to collect metal waste; instead the 706-A waste is transfered to tank W-4 by means of 50 gal stainless steel drums after it has been neutralized.

The Hot Pilot Plant metal waste is jetted to tank W-4 through the second 3 inch stainless steel line from cell 2 described in Section 4.2 above. Since the valve in this line at W-4 is normally kept closed to allow chemical waste to drain to W-3, metal waste transfers have to be made by arrangement with the tank farm operator. The waste is neutralized before each transfer and records are kept of the uranium content.

Bldg. 706-HB has a 1200 gal thorium waste tank but no tank for uranium. Uranium waste is transferred to tank W-4 in drums after it is neutralized.

Hexone containing uranium from Argonne National Laboratories is distilled in a small vessel in the South Tank Farm near tank W-10. The uranium contained in the concentrate from the hexone still is transferred to tank W-10; condensed hexone drains to the Retention Pond through the W-10 dry well. At times as much as 250 gal. of hexone per week are discharged in this fashion.

Tank Farm Metal Handling Procedures: Uranium waste is precipitated in tanks W-4, W-7, and W-10 after each tank has filled with metal waste. The precipitation is made by adding 50% NaOH to the tank at a rate of five thirty gallon drums per shift until caustic amounting to 1/15 th of the liquid volume of the tank has been added. The tank is air-agitated during the caustic addition and then allowed to settle for two or three months if sufficient capacity in other tanks is available for collecting current wastes. The supernate from the uranium precipitation is jetted to the ruthenium recovery unit for Ru removal, then to W-12 and finally to W-5.

The ORNL uranium waste tanks were sampled 11/23/48 to determine the composition of the sludge and supernatant, preliminary to undertaking a development program for metal recovery. These samples were analyzed and results are shown in Table VI.

8.0 Conclusions

8.1 Concentrating Liquid Waste

Since present A. E. C. policy demands that discharge of activity to streams be eliminated or drastically reduced, all radioactive liquid waste must be concentrated and stored. Metal waste has been concentrated by precipitation for several years, and experiments in concentrating radiochemical waste by evaporation have proved successful on a pilot plant scale. A large evaporator for reducing the volume of the entire flow of ORNL radiochemical waste by a factor of 20 to 1 is now under construction.

8.2 Storage Space

Existing tanks in the tank farm can provide adequate storage capacity for metal waste and radiochemical waste concentrated from the total flows of these streams for several years.

A. Future Capacity for Radiochemical Waste

When the metal waste now in tank W-8 is transferred to one of the other waste metal tanks, W-8 can be used to store concentrated raciochemical

Drawing # 7038

[redacted]

TABLE VI

ORNL METAL WASTE ANALYSES

Tank No.	Phase Sampled	U	Na	NO_3	CO_3	PO_4	SO_4	Gross β	Gross γ	Ru β	Ce β	Cs β	Sr β
		Ionic Content mg/ml						Radiochemical Content c/m/ml					
W-3	Supernate	0.02	110	13.7	33.8	2.4	104	$1.9x10^5$	$0.58x10^3$	$8.3x10^4$	$0.06x10^4$	$14.3x10^4$	$0.52x10^2$
W-4	"	8.9	2.3	14.5	0.4	0.1	8.3	$12.7x10^5$	$2.1 x10^3$	$4.0x10^4$	$50.0 x10^4$	$2.9x10^4$	$1900 x10^2$
W-7	"	0.02	54.2	15.9	29.3	6.0	132	$26.0x10^5$	$0.58x10^3$	$9.6x10^4$	$3.2 x10^4$	$17.2x10^4$	$1.7 x10^2$
W-10	"	0.02	74.1	22.4	33.0	8.7	104	$29.8x10^5$	$0.9 x10^3$	$8.1x10^4$	$4.7 x10^4$	$26.9x10^4$	$4.2 x10^2$
W-8*	"	16.1	39.9	15.4	27.8	7.2	227	$8.5x10^5$	$1.4 x10^3$	$9.4x10^4$	$50.3 x10^4$	$16.9x10^4$	$74.1 x10^2$
		mg/g						c/m/g					
W-3	Sludge	539	143	22.8	60	12.5	8.6	$19.1x10^6$	$14.0 x10^3$	$7.4x10^5$	$11.8 x10^6$	$3.1x10^5$	$1.2 x10^6$
W-4	"	326	190	42.5	51	218	146	$4.5x10^6$	$1.3 x10^3$	$0.9x10^5$	$1.3 x10^6$	$1.2x10^5$	$1.3 x10^6$
W-7	"	475	170	34.9	67	90	214	$3.2x10^6$	$1.2 x10^3$	$7.8x10^5$	$0.7 x10^6$	$1.6x10^5$	$0.7 x10^6$
W-10	"	485	164	43.5	49	90	105	$8.2x10^6$	$2.4 x10^3$	$2.0x10^5$	$4.2 x10^6$	$2.5x10^5$	$1.5 x10^6$

* This tank is used as a collection tank, and no uranium is precipitated here.

These samples wewe taken 11-23-48 by P.B. Orr; Ionic analyses were reported by P.F. Thomason; radiochemical results were repotyed by C.S. Burros; counting was done at 6.18% geometry with no absorber.

TABLE V

[redacted]

waste. Since tank W-5 must be maintained as a surge tank, the storage space available for concentrated radiochemical waste will be:

W-6	170,000 - 26,000	= 144,000 gal.
W-8	170,000 - 7,000	= 163,000 gal.
	Total	= 307,000 gal.

If the 30,600 gal per week average flow of this waste can be reduced in volume by a ratio of 30 to 1 by evaporation, then 1020 gal per week will have to be stored. The available storage in tanks W-6 and W-8 will thus last 300 weeks. At 20 to 1 volume reduction the space would be filled in 200 weeks. This means that our existing storage facilities would provide a minimum of three years storage.

B. <u>Future Capacity for Metal Waste (U & Pu)</u>

Available space for Metal (U & Pu)waste is:

W-4	41,200 - 6,000	= 35,200 gal.
W-7	166,000 - 30,000	= 136,000 gal.
W-10	170,000 - 60,000	= 110,000 gal.
		281.200 gal.

The average flow of metal waste is 1500 gal per week. This gives a liquid storage capacity of 187 weeks, and with a volume reduction of 25 to 1 by precipitation the solid storage capacity for Pu & U waste is 4675 weeks. This does not include space available in tank W-9, as this tank is used only as a collection and dispersion tank for liquid metal waste.

C. Future Capacity for Thorium Waste

Thorium bearing waste is stored at present in the Bldg. 706-A Metal Waste tank (described in Section 7.2 above) and in 50 gallon stainless steel drums stored just east of Bldg. 706-A. The estimated production of thorium waste at ORNL is 200 gallons per week for 1 month. This means that storage space for thorium in the 1200 gal. 706-HB tank is adequate only for the present plan of production. No plan for further processing of thorium waste to reduce its volume has yet been devised, although thorium metal recovery is being investigated.

8.3 Faults of the Existing Waste System

Several serious faults can be found with the present liquid waste system. They are:

A. Control of the quantity of activity discharged into any of the waste streams under the present system of operation is impossible. The fact that waste from several large contributors must pass through a single small tank (W-12) frequently causes difficulty because of necessary overflows to the process waste system (see Section 4.2 above). This fault together with a number of piping connections which cause certain contributors to discharge to the improper waste system results in: (1) the large volume process waste stream at times having too high an activity level: (2) the high activity radiochemical waste stream having too large a volume of flow for the existing hold-up system to allow for sufficient decay of long-life activity before discharge to the creek, (3) providing no means for a radiochemical waste concentrating device to select and control its feed.

B. The inability of the present radiochemical waste hold-up tanks to handle acid waste makes a waste concentrating scheme more difficult.

C. The metal waste and radiochemical waste streams intermix because Bldg. 706-C has no separate metal waste system (see 7.2 above). Metal waste from dissolver rinses at the Hot Pilot Plant must be discharged from Cell 1 through the radiochemical line, and a portion of the line from the Hot Pilot Plant Cell 2 to tank W-3 must carry both metal and radiochemical wastes. (see Section 7.2 above).

D. An explosive solvent is released into the waste system from the hexone still near tank W-10.

E. Existing Tanks have no adequate means for agitating their contents to insure proper mixing for sampling and precipitating.

F. Existing tanks have vents open to the atmosphere.

G. Existing tanks have insufficient number of openings for present lines to them.

9.0 Recommemdations

Recommendations for relieving the ills listed above are:

A. Change piping connections to reduce the volume of the radiochemical and warm waste streams and to reduce the activity of the process waste stream. This can be accomplished by:

1. Providing "hot" sinks in Bldg. 706-A rooms 6 & 8, 25, 27, 31, 33, 35, 61, and 78; in Bldg. 706-D balconies; in Bldg. 105 laboratories on the east side of the building; in the Bldg. 205 analytical lab.
2. Changing Bldg. 205 roof drains from the warm waste system to the process system.
3. Changing the Bldg. 205 stack drain from the warm waste system to the process system.
4. Changing cooling water from vessels in Cell 5, Bldg. 205 from warm waste system to the process system.
5. Changing cooling water from vessel in Bldg. 706-C cell from radiochemical waste system to the process system.
6. Changing Bldg. 115 fan seals to drain to process system since the pile air filters have been installed.

B. Connect the 706-C metal waste tank to the line from Bldg. 706-D to tank W-9 to eliminate the cross-over between metal and chemical waste systems through W-12.

C. Provide stainless steel collection tanks at the following buildings to furnish more hold-up capacity for radio-chemical waste and at the same time to furnish a means of flow control for waste concentration scheme:

<u>Bldg. 706-A</u> - use tank W-12 to receive radiochemical waste from 706-A alone.

<u>Bldg. 706-C and 706-D</u> - Install one 20,000 gal stainless steel tank in the South Tank Farm to receive from both buildings and to jet discharge to tank W-5 or an evaporator feed tank.

<u>Bldg. 205</u> - Install one 2000 gal. stainless steel tank in the North Tank Farm to receive radiochemical waste only from the Hot Pilot Plant.

D. Install a stainless steel waste metal collection tank for Bldg. 706-A.

E. Further investigate flows of all waste streams to eliminate cross-overs between streams of different activity levels.

F. Initiate a survey of the major sources of waste in order to determine if processes can be altered to reduce the quantities of liquid waste produced.

G. Recover hexone received from outside sites instead of distilling it to tank W-10 dry-well. Facilities for hexone recovery are already in existence at ORNL and most of the hexone used here is recovered.

H. Initiate a survey to track down the source of chlorides in the radiochemical waste stream and to devise a method of handling them so as to prevent their causing a corrosion problem at the evaporator.

I. Investigate the feasibility of providing the waste collection tanks with a closed vent system connected to an existing stack.

10.0 Future Program

10.1 Evaporator

The design work has been completed on an evaporator capable of handling 300 gal. per hour of radiochemical waste. Construction was started on March 7, 1949. The volume reduction is to be 20 to 1 at 10^3 or better decontamination.

10.2 Nitric Acid Recrystallization

Experimental and process development work is now in progress on a scheme for concentrating radioactive wastes by recrystallization of all ions except the fission products from fuming nitric acid. The most promising plan seems to be: (1) to take W-6 waste and make its pH = 11 by sodium hydroxide addition; this would precipitate any U for easy recovery by centrifuging. (2) Addition of ferric ions to the supernate to precipitate ferric hydroxide and scavenge Ru. In addition, a MnO_2 scavenge for further decontamination may be used. (3) The precipitates would then be centrifuged and the supernate from this step evaporated to a heavy slurry. (4) Subsequent treatment of the slurry with fuming nitric acid would cause aluminum, sodium, and other bulk cations to crystalize, leaving almost all the activity dissolved in the acid. (5) Evaporation of the acid mother-liquor would leave the activity concentrated in any desired volume. A total beta decontamination factor of 7×10^3 was obtained on three successive laboratory scale experiments. A report on this work will be issued by I. R. Higgins of the Chemical Process Development Section of the Technical Division.

10.3 Ion Exchange

Semi-works scale experiments on waste decontamination and activity concentration by means of ion-exchange resin beds indicate a simple, practical process capable of yielding a decontamination factor of 10^2 and a volume reduction of 10^3 on Na and Al- free wastes. The disadvantages of this process are the interference of sodium and aluminum and the inability of the resin to absorb Ru and Te. The process is: Pass aluminum and sodium-free waste over a resin bed in an absorption column. Then add ferric ions to the waste solution and filter. The filtrate can then be discharged. The activity is concentrated in the filter cake and on the resin bed. A small volume of acid will dissolve out the activity from both places.

10.4 Condensate Decontamination

The use of ion exchange resins to decontaminate condensate from waste evaporation is to be investigated.

10.5 Further Surveys

A survey will be made on the flows of each type of waste in an effort to determine a method of reducing the volumes of these flows. A proposal will be drawn up for means of segregating the various waste streams and of establishing closer control of these streams at their sources.

Frank N. Browder
March 28, 1949

11.0 Appendix

11.1 Bibliography

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    b. Memo "206 Area Ponds" by Nylen to Leverett, Feb.22, 44.

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    b. Letter, S. K. Allison to Col. K. D. Nichols, October 20, 1944

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   b. Memo "Algae Control" by R. L. Doan, Oct. 14, 1944

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16. Central Files Folder "Safety Waste Disposal-Jan. to June, 1944:

   a. Memo "Metal Waste" by M. C. Leverett, June 19, 1944

   b. Memo "Disposal of Hot Solutions" by H. S. Brown, May 24, 1944

   c. Memo "Meeting on Decontamination of Chemical Wastes" bu W. O. Smith, May 20, 1944

   d. Memo "Re: Disposal of Contaminated Plant Wastes" by C. M. Cooper, May 12, 1944

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11.2 List of Drawings

1. Bldg. 706-A W69128 Plumbing & Drainage Key Plan
2. Bldg. 706-A W69131 Plumbing & Drainage Sheet 1
3. Bldg. 706-A W69132 Plumbing & Drainage Sheet 2
4. Bldg. 706-A W69133 Plumbing & Drainage Sheet 3
5. Bldg. 706-A W69134 Plumbing & Drainage Sheet 4
6. Bldg. 706-A W69135 Plumbing & Drainage Sheet 5
7. Bldg. 706-A W69136 Plumbing & Drainage Sheet 6
8. Bldg. 706-A W69289 Plumbing & Drainage Sheet 7
9. Bldg. 706-B W69108 Plumbing & Drainage Plans & Details
10. Bldg. 706-C CL-706C-16 Arrangement & Details of Valve Pit
11. Bldg. 706-C CL-706C-17 Arrangement & Detail of Hold-up Tank
12. Bldg. 706-C CL-706C-18 Concrete Arrgt. & Det., Hold-up Tank
13. Bldg. 706-C CL-706C-19 Arrgt. & Details Air Supply & Inst. Piping
14. Bldg. 706-C D-894 Addition to North Side, Drainage Plans
15. Bldg. 706-C W72658 Plumbing & Drainage Plans & Details
16. Bldg. 706-D Cl-706D-5 Composite Map
17. Bldg. 706-D CL-706D-10 Bldg. Drainage: Piping Below Floor Level
18. Bldg. 706-D CL-706D-277 Bldg. Process
19. Bldg. 706-G D-1253 Source Bldg. Process & Hot Sewers
20. Bldg. 706-G D-1254 Source Bldg. Hold-up Tank Arrangement & Detail
21. Bldg. 706-G D-1051 Source Bldg. Lay-out & Elev.

22. Bldg. 706-G E-1084 Source Bldg. Concrete Cell
23. Bldg. 706-HB D-2892 Solvent Col. Lab. Outside Underground Services
24. Bldg. 706-HB D-2893 Solvent Col. Lab. Outside Underground Services Details
25. Bldg. 706-HB D-2896 Solvent Col. Lab. Bldg. Service Drainage Plan
26. Bldg. 706-HB D-3222 Solvent Col. Lab. Bldg. Contam. Drainage Plan
27. Bldg. 706-HB D-3303 Solvent Col. Lab. Bldg. Service Draingae Det. Sheet 1.
28. Bldg. 706-HB D-3557 Solvent Col. Lab. Contam. Storage Tanks Sheet 1
29. Bldg. 706-HB D-3558 Solvent Column Lab. Contam. Storage Tanks Sheet 2
30. Bldg. 706-HB C-3644 Solvent Column Lab. Bldg. Service Drainage Detail Sheet 2
31. Bldg. 706-HC D-3580 Piping Jet Pit & Control House
32. Bldg. 706-HC D-3584 Jet Pit and Tank Foundation
33. Bldg. 101 D-830 Addition to East Side, Fur. & Sewer Plans
34. Bldg. 101-B D-3677 Met. Eng. Lab. Service & Drainage Piping
35. Bldg. 101-B E-1081 Met. Eng. Lab. Bldg. Sewers
36. Bldg. 105 W69106 Plumbing & Drainage Plans & Details
37. Bldg. 105 W69121 Plumbing & Drainage First & Second Floors Labs.
38. Bldg. 105 W68868 Pile Canal Drain

39. Bldg. 114 Austin X-17 Pile Filter House Hot & Process Drainage System
40. Bldg. 115 W68908 Plumbing & Drainage Plan
41. Bldg. 204 D-3956 Service Piping & Drainage
42. Bldg. 205 W66040 Plumbing & Drainage Plan
43. Bldg. 205 W68330 Plot Plan
44. Bldg. 205 E-5393 Bldg. Process Drainage Plan
45. Bldg. 206 CL-206-1 (A) Settling & Storage Basin-Location Plan
46. Bldg. 206 CL-206-2(A) Settling & Storage Basin Sections
47. Bldg. 206 CL-206-5(D) Settling & Storage Basin
48. Bldg. 206 CL-206-9(D) Active Waste Lines & Storage Tanks
49. Bldg. 206 D-3246 Tank W-12 & Details
50. Bldg. 206 D-3247 Tank W-12 Piping Plan (shows W-11 also)
51. Bldg. 206 D-3813 Ru^{106} Tank Arrgt., Plans,& Elev.
52. Bldg. 206 D-3814 Ru^{106} Tank Piping Arrgt. Plans & Details
53. Bldg. 206 D-3971 Relocation of Transfer Piping in Tank Farm.
54. Bldg. 206 C-4249 Alterations to Transfer Lines-Piping Connect.
55. Bldg. 206 D-5334 Tank Farm Evap. Outside Process Piping
56. Bldg. 206 B-5180 Tank Farm Evap. Plot Plan
57. Bldg. 206 W68331 Tank Farm Plot Plan
58. Bldg. 206 W68332 Hold-up Tanks (W-1 & W-2) Arrgt., Plans, & Sect.
59. Bldg. 206 W68333 25' Dia. Tanks (W-3 & W-4) Arrgt., Plans & Sect.

60. Bldg. 206 W68335 Plug Valves for Eq. Pieces 101, 110, and 120 Det.

61. Bldg. 206 W68336 Concrete Foundations & Details

62. Bldg. 206 W68343 Gunite Tank Connect. Arrgt., Plans, and Details

63. Bldg. 206 W69065 Catch Tank (W-11) Arrgt.,Plan & Sect.

64. Bldg. 206 D-5464 206-900 Area 2"SS Drain-Plan & Sect. Sheet 1.

65. Bldg. 206 D-5465 206-900 Area 2"SS Drain-Plan & Sect. Sheet 2

66. Bldg.717-BB E-2141 Research Shops Underground Services

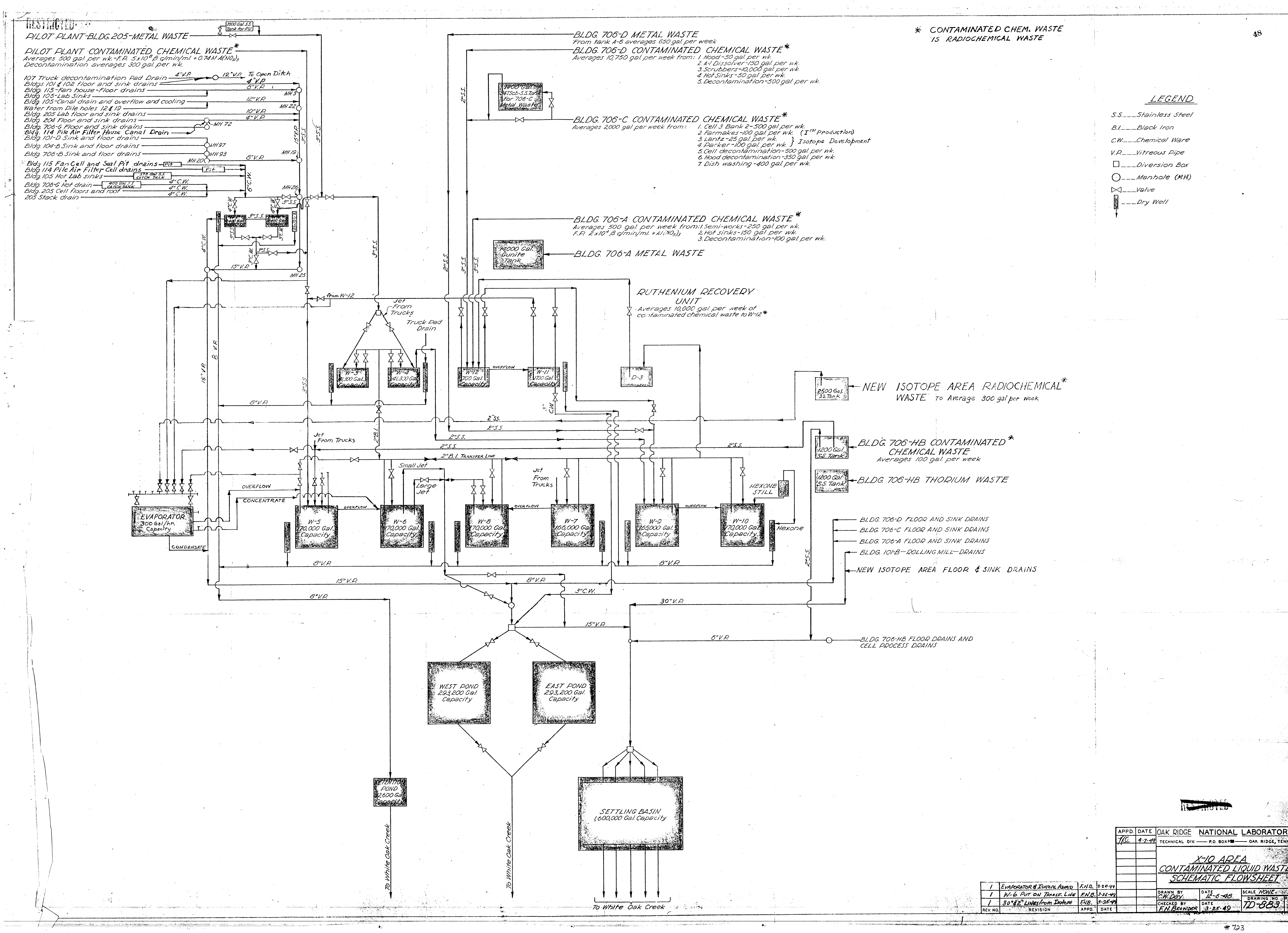
67. Bldg. 717-BB D-4509 Research Shops Outside Process Sewer

68. Bldg. 717-BB E-4482 Research Shops Piping Plans & Sections

69. Bldg. 807 W70132 Water Treatment House Plumbing & Drainage

11.3 List of Maps

1. Map 603 Drawing E-542 Rev. 9 Bldgs. & Roads(July 1,1948)
2. Map 625 Drawing E-556 Process & Sanitary Sewer Lines
3. Map 2844 Topographic Map
4. Map 2847 Outside Lines & Sewers
5. Map 2848 Outside Lines-Key Map
6. Map 2875 Sheet 1 Outside Lines-Sewers & Drains
7. Map 2875 Sheet 2 Outside Lines-Sewers & Drains
8. Map ORNL Area Atlas Drawings D-5201 to D-5246
9. Map Process Waste Disposal Exclusion Area Sheets 1 to 5 Drawings E-5381 to E-5385


RESTRICTED
PILOT PLANT-BLDG. 205-METAL WASTE
2000 Gal. S.S. Tank for PU
PILOT PLANT CONTAMINATED CHEMICAL WASTE*
Averages 500 gal. per wk.-F.P. 5x10^6 β d/min/ml. + 0.74 M Al(NO3)3
Decontamination averages 300 gal. per wk.
107 Truck decontamination Pad Drain
Bldgs 101 & 102 floor and sink drains
Bldg. 115-Fan house-Floor drains
Bldg. 105-Lab Sinks
Bldg. 105-Canal drain and overflow and cooling
Water from Pile holes 12 & 19
Bldg. 205 Lab floor and sink drains
Bldg. 204 Floor and sink drains
Bldg. 706-G Floor and sink drains
Bldg. 114 Pile Air Filter House Canal Drain
Bldg. 101-D Sink and floor drains
Bldg. 104-B Sink and floor drains
Bldg. 706-B Sink and floor drains
Bldg. 115 Fan Cell and Seal Pit drains
Bldg. 114 Pile Air Filter Cell drains
Bldg. 105 Hot Lab sinks
Bldg. 706-G Hot drain
Bldg. 205 Cell floors and roof
205 Stack drain
To Open Ditch
MH 3
MH 22
MH 72
MH 97
MH 93
MH 19
MH 20
MH 26
MH 25
From W-12
Jet From Trucks
Truck Pad Drain
W-3
W-4
EVAPORATOR 300 Gal/hr. Capacity
OVERFLOW
CONCENTRATE
CONDENSATE
Jet From Trucks
Small Jet
Large Jet
2" B.I. TRANSFER LINE
W-5 170,000 Gal. Capacity
W-6 170,000 Gal. Capacity
W-8 170,000 Gal. Capacity
W-7 166,000 Gal. Capacity
W-9 165,000 Gal. Capacity
W-10 170,000 Gal. Capacity
Hexone
HEXONE STILL
BLDG. 706-D METAL WASTE
From tank A-6 averages 650 gal. per week
BLDG. 706-D CONTAMINATED CHEMICAL WASTE*
Averages 10,750 gal. per week from: 1. Hood-50 gal. per wk.
2. A-1 Dissolver-150 gal. per wk.
3. Scrubbers-10,000 gal. per wk.
4. Hot Sinks-50 gal. per wk.
5. Decontamination-500 gal. per wk.
BLDG. 706-C CONTAMINATED CHEMICAL WASTE*
Averages 2,000 gal. per week from: 1. Cell 3 Bank 2-500 gal. per wk.
2. Farmakes-100 gal. per wk. (I^131 Production)
3. Lantz-25 gal. per wk.
4. Parker-100 gal. per wk. } Isotope Development
5. Cell decontamination-500 gal. per wk.
6. Hood decontamination-350 gal. per wk.
7. Dish washing-400 gal. per wk.
BLDG. 706-A CONTAMINATED CHEMICAL WASTE*
Averages 500 gal. per week from: 1. Semi-works-250 gal. per wk.
F.P. 2x10^6 β d/min/ml. + Al(NO3)3 2. Hot sinks-150 gal. per wk.
3. Decontamination-100 gal. per wk.
BLDG. 706-A METAL WASTE
Gunite Tank
RUTHENIUM RECOVERY UNIT
Averages 10,000 gal. per week of contaminated chemical waste to W-12*
W-12
W-11
D-3
2500 Gal. S.S. Tank
NEW ISOTOPE AREA RADIOCHEMICAL* WASTE To Average 300 gal per week
1200 Gal. S.S. Tank
BLDG. 706-HB CONTAMINATED* CHEMICAL WASTE
Averages 100 gal. per week
BLDG. 706-HB THORIUM WASTE
BLDG. 706-D FLOOR AND SINK DRAINS
BLDG. 706-C FLOOR AND SINK DRAINS
BLDG. 706-A FLOOR AND SINK DRAINS
BLDG. 101-B-ROLLING MILL-DRAINS
NEW ISOTOPE AREA FLOOR & SINK DRAINS
BLDG. 706-HB FLOOR DRAINS AND CELL PROCESS DRAINS
8" V.P.
15" V.P.
30" V.P.
6" V.P.
3" C.W.
2" S.S.
3" S.S.
WEST POND 293,200 Gal. Capacity
EAST POND 293,200 Gal. Capacity
RETENTION POND 2,600 Gal. Capacity
SETTLING BASIN 1,600,000 Gal. Capacity
To White Oak Creek
To White Oak Creek
To White Oak Creek
* CONTAMINATED CHEM. WASTE IS RADIOCHEMICAL WASTE
LEGEND
S.S.___Stainless Steel
B.I.___Black Iron
C.W.___Chemical Ware
V.P.___Vitreous Pipe
___Diversion Box
___Manhole (MH)
___Valve
___Dry Well
1 EVAPORATOR & ISOTOPE ADDED F.N.B. 3-25-49
1 W-6 PUT ON TRANSF. LINE F.N.B. 3-25-49
1 30" & 2" LINES from Isotopes F.N.B. 5-25-49
REV. NO. REVISION APPD. DATE
APPD. DATE
4-7-49
OAK RIDGE NATIONAL LABORATORY
TECHNICAL DIV. — P.O. BOX — OAK RIDGE, TENN.
X-10 AREA
CONTAMINATED LIQUID WASTE
SCHEMATIC FLOWSHEET
DRAWN BY C.W. Day
DATE 12-6-48
SCALE NONE
CHECKED BY F.N. Browder
DATE 3-25-49
DRAWING NO. TD-883
REV. 1

#723